Post-Flight Evaluation of Stardust PICA Forebody Heatshield Material

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Phenolic Impregnated Carbon Ablator (PICA) was developed at NASA Ames Research Center under the lightweight ceramic ablator development program in the '80s. PICA has the advantages of low density (~ 0.27g/cc) coupled with efficient ablative capability at high heat fluxes making PICA an enabling technology for the Stardust mission. Three cores at key locations were extracted from the forebody heatshield of the Stardust Sample Return Capsule (SRC) post flight and evaluated. Core locations include a near stagnation core, a flank core and a segment taken from the shoulder of the heatshield. Evaluation included density profiles, recession determination, thermal analysis profile, PICA bondline examination, strength of remaining virgin PICA, emissivity profile, chemical analysis profile and microstructural analysis. Comparisons between experimental density profiles and profiles derived from FIAT, a tool used to predict ablative performance, are in good agreement. Recession comparisons from measured values and FIAT predictions are currently being obtained. In addition a laser scanning tool developed at ARC is being used to evaluate recession measurements and compare to experimental and predicted values. In general, the PICA material examined in the cores is in good condition and intact. Impact damage is not evident and the main degradation observed was that caused by heating on entry. A substantial amount of "virgin" PICA was present in all cores examined. It is noted that the post-flight analysis of the Stardust heat shield is especially important since PICA is baselined for both the Orion (CEV) and Mars Science Laboratory vehicles.

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